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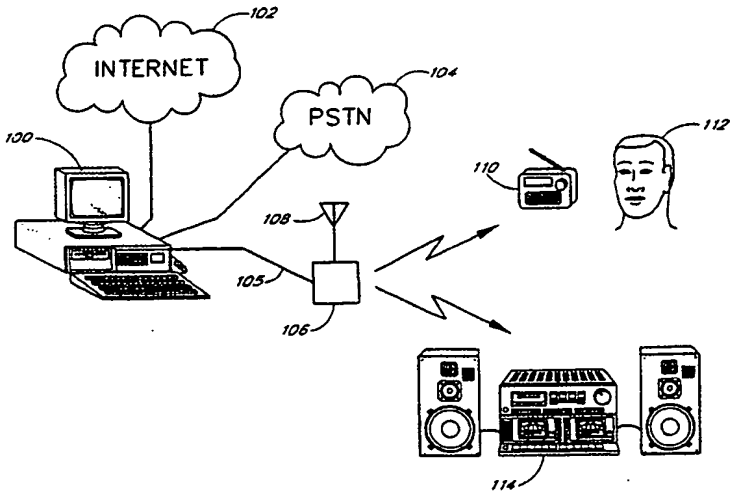
(54) Title: REMOTE AUDIO COMPUTER PERIPHERAL DEVICE



(57) Abstract

A computer audio peripheral device (106) that converts digital audio data from the computer (100) into a radio frequency (RF) signal and transmits the RF signal to a radio receiver (110) is described. The audio peripheral device is connected to the computer by a digital communication interface (105) such as a parallel port, printer port, serial port, Universal Serial Bus (USB) port, Network port, and the like. The audio peripheral device transmits audio information to a radio receiver thereby freeing the listener (112) from the computer while still allowing the listener to enjoy the benefits of computer generated audio. This frees the listener from the computer and allows the listener to move about the house, yard, etc. while still listening to web radio broadcasts and other computer generated audio programming.

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REMOTE AUDIO COMPUTER PERIPHERAL DEVICE

Background of the Invention

Field of the Invention

The present invention relates to the field of computer-generated audio, and more particularly to computer peripherals to distribute computer generated audio.

Description of the Related Art

Since the introduction of the microprocessor in the late 1970's, and the subsequent introduction of the personal computer in the early 1980's, the computer has gone from a specialized tool used only in business and research, to a common household appliance. The computing power and capabilities of computer systems have increased at an exponential rate, while the price of the systems dropped dramatically. Perhaps nowhere has the increased power of the computer been more apparent than in the ability of the computer to process audio information. Today, even the most basic of personal computer systems typically come equipped with a CD-quality audio card that transforms digital audio data into analog audio data to be reproduced by loudspeakers.

Personal computers can receive digital audio data from many sources, including digital audio data stored on CD-ROMS, digital audio data stored on audio CDs, digital audio data stored in disk files, digital audio data generated in real-time by programs running on the computer, and digital audio data received from the Internet.

The internet is a worldwide array of interconnected computers and information servers that allow anyone with a computer an access to the Internet to get information about virtually any subject 24 hours a day. For the average consumer, an Internet Service Provider (ISP) provides access to the Internet. ISPs such as CompuServe, Prodigy, and America On-Line, currently link over ten million users to the Internet. Users typically connect to the ISP by using standard telephone lines and a telephone modem. Cable modems that allow a user to connect to the ISP over cable television lines, and satellite connections to the Internet, are also available.

The Internet provides a wealth of information from stock reports to headline news. One of the newer services provided on the Internet is a streaming audio (e.g., RealAudio) service. Streaming audio services are often provided in connection with the World Wide Web (Web) and thus are often called Web radio broadcasts. With streaming audio, a user with a Personal Computer (PC), a sound card, and the necessary software can listen to audio programs from anywhere in the world. For example, Radio Prague provides daily Internet broadcasts from the Czech Republic.

Listeners in the U.S. can listen to these Web radio broadcasts either in real time, or stored for later replay. Thus, unlike more traditional radio broadcasts where the listener must be within a reception area, Web radio broadcasts can be heard anywhere, so long as the listener has a connection to the Internet and the necessary computer hardware and software. However, the use of a computer for digital audio is not without drawbacks.

One drawback to the use of computers as a source of digital audio lies in the fact that many people only have one computer, and in many cases, that computer is set up in a home office or spare bedroom. Such setups are good when the computer is used for more serious pursuits such as business, word-processing, etc. However, such setups are less than ideal when the computer is used for more relaxing purposes such as listening to a web radio broadcast or digital audio program. Moreover, many computer systems also provide audio notification functions to tell a user that an event has occurred, such as the receipt of an email, a facsimile, etc. Unfortunately, if the user is not close enough to the computer to hear the audio notification, the user will not know that a message has been received.

Of course, a user could run loudspeaker wires from the computer to other areas of the house, thereby allowing the loudspeakers to be remotely located, but such a solution is inconvenient at best, and not very practical for someone who lacks the requisite technical knowledge needed to install the wiring. Moreover, using long wires to remotely connect loudspeakers to a computer is a poor solution because long wires will tend to degrade the quality of the sound produced by the computer. Long wires will degrade the sound quality by adding substantial inductance to the signal path, and by picking up hum from the 60 Hz wiring in the house. Running long wires is also potentially hazardous to the computer because the long wire provides a pathway for high voltage spikes, such as spikes induced by lightning, to enter the computer.

Another drawback to computer generated audio arises because most computer systems are configured as single user systems. Most personal computers have more than enough processing power to allow one family member to use the computer to listen to a web radio broadcast while another family member is using the computer for games, word processing, etc. However, since few, if any, personal computers have more than one sound card, it is virtually impossible for two people to use the computer at the same time when both people want to listen to audio information provided by the computer.

Finally, even though the cost of computers has continued to drop, many computer manufacturers are continually looking for ways to cut the cost of a computer system. Many users, especially home users, already have an FM radio or a component stereo system with speakers and an FM radio. For these users, the cost of loudspeakers supplied with a computer system is a waste of money. The users would be equally happy to use their existing loudspeakers, rather than pay for new computer loudspeakers. What these users need is a simple way to connect the computer to the existing loudspeakers.

Summary of the Invention

The present invention solves these and other problems by providing a convenient computer audio peripheral device that converts digital audio data from the computer into a radio frequency (RF) signal and transmits the RF signal to a radio receiver. The audio peripheral device is connected to the computer by a digital communication interface such as a parallel port, printer port, serial port, Universal Serial Bus (USB) port, Network port, and the like. The audio peripheral device transmits audio information to a radio receiver thereby freeing the listener from the computer while still allowing the listener to enjoy the benefits of computer generated audio. This frees the listener from the computer and allows the listener to move about the house, yard, etc. The user can go about life's normal tasks while still listening to web radio broadcasts and other computer generated audio programming.

The audio peripheral provides the audio playback functions of a conventional computer sound card, and is thus, in effect, a second sound card. This allows the compute to provide audio to two users, since a first user can listen to audio produced by a soundcard and speakers near the computer and a second user can listen to audio that the audio peripheral sends to a remote radio receiver.

The audio peripheral also allows the computer manufacturer to reduce the cost of a computer system by omitting the soundcard and computer speakers. The manufacturer provides the audio peripheral and the end-user provides the radio receiver and speakers.

In one embodiment, the audio peripheral device transmits a low-power standard FM-mono or FM-stereo signal that can be received by any conventional FM radio.

In one embodiment, the audio peripheral includes software that runs on the personal computer to allow a user configure the audio peripheral, select audio program material, etc.

In yet another embodiment, the audio peripheral provides additional functions such as a notification function to inform a listener, who may be outside the house, that the telephone is ringing, that the doorbell is ringing, that the user has received email, etc.

Brief Description of the Figures

The various novel features of the invention are illustrated in the figures listed below and described in the detailed description that follows.

Figure 1 is a perspective view of one embodiment of an audio peripheral device that transmits computer-generated audio to a remote radio receiver.

Figure 2A is a block diagram of a single-channel audio peripheral device.

Figure 2B is a block diagram of a dual-channel (stereophonic) audio peripheral device.

Figure 3 is a flowchart that illustrates the operation of a notification function.

In the figures, the first digit of any three-digit number indicates the number of the figure in which the element first appears.

Detailed Description of the Preferred Embodiment

Figure 1 is a perspective view of one embodiment of an audio peripheral 106 that transmits computer-generated audio from a computer 100 to remote radio receivers 110 and 114. The audio peripheral 106 is connected to the computer 100 by a digital bus 105. The audio peripheral 106 obtains digital audio information from the computer 100, modulates the audio onto an RF carrier, and provides the RF information to an antenna 108. The antenna 108 radiates the RF energy to radio receivers, such as a portable radio 110 and a component stereo system 114.

The computer 100 is optionally connected to the Internet 103 such that the computer 100 can obtain digital audio data, such as streaming audio, from the Internet. The computer can access the Internet by any type of network connection, including, for example, a telephone modem, a cable modem, a satellite connection, an ISDN connection, a local area network connection, etc. The computer 100 is also optionally connected to a Public Switched Telephone Network (PSTN). It is not necessary for the computer 100 to have a sound card.

The bus 105 is preferably a digital communication interface such as a parallel port, printer port, serial port, Universal Serial Bus (USB) port, FireWire (IEEE 1394) bus, Network port, and the like. In one embodiment, the bus 105 is a USB and the audio peripheral 106 draws all of its needed electrical power from the bus 105. In another embodiment, the audio peripheral 106 uses a separate power supply.

In one embodiment, the audio peripheral device transmits a low-power standard AM or FM signal that can be received by any conventional AM/FM radio. Figure 2A is a block diagram of a single-channel audio peripheral device 200 configured to transmit to a conventional AM or FM radio. The peripheral device 200 includes a computer interface 202, a digital to analog converter (DAC) 204 and a radio transmitter 206. The computer interface 202 is connected to the computer bus 105 and communicates with the computer 100. The computer interface 202 receives digital audio data from the computer 100 and provides the digital audio data to a digital input of the DAC 204. An analog output of the DAC 204 is provided to a baseband audio input of the radio transmitter 206. The transmitter 206 modulates the baseband audio onto an RF carrier signal and provides the modulated RF signal to the antenna 108. A one-way or two-way command and status bus 201 is provided to connect the radio transmitter 206 to the computer interface 202.

In one embodiment, the computer interface receives control commands such as the type of modulation (AM or FM), the frequency, etc., from the computer 100 and sends the control commands to the transmitter 206. In one embodiment, the computer 100 sends query commands, such as a request to query operational status of the transmitter, to the computer interface 202. The computer interface 202 queries the transmitter 206 and sends the query information back to the computer 100.

Figure 2B is a block diagram of a two-channel (stereo) audio peripheral device 250 configured to transmit to a conventional AM or FM radio. The peripheral device 250 includes a computer interface 252, a left-channel digital to analog converter (DAC) 254, a right-channel digital to analog converter (DAC) 255 and a radio transmitter 256. The computer interface 252 is connected to the computer bus 105 and communicates with the computer 100. The computer interface 252 receives digital audio data from the computer 100 and provides the digital audio data to a digital input of the DAC 254 and to the DAC 255. An analog output of the DAC 254 is provided to a left-channel baseband audio input of the radio transmitter 256. An analog output of the DAC 255 is provided to a right-channel baseband audio input of the radio transmitter 256. The transmitter 256 modulates the left and right baseband audio channels onto an RF carrier signal and provides the modulated RF signal to the antenna 108. A one-way or two-way command and status bus 201 is provided to connect the radio transmitter 256 to the computer interface 252.

Operation of the two-channel audio peripheral 250 is similar to the operation of the single-channel device 200 except that the two-channel device 250 accepts left and

right channel digital data from the computer 100 and provides left and right audio channels to the radio receivers.

In one embodiment, the audio peripheral includes software that runs on the personal computer to allow a user to configure the audio peripheral, to select audio program material, to select a modulation format (e.g., AM, AM-stereo, FM, FM-stereo, etc.), to select a frequency (channel) of operation, etc.

Conventional amplitude modulation (AM) and conventional frequency modulation (FM) are analog modulation schemes, and thus the DACs 204, 254, 255 are provided to convert the digital data from the computer into analog data for the transmitter. One skilled in the art will recognize that digital modulation schemes are known. When the radio transmitter 206, 256 use digital modulation, the DACs are omitted and the digital data is provided from the computer interface (202, 252) to the radio transmitter (206, 256).

Notification Feature

In one embodiment, the audio peripheral provides additional functions such as a notification function to inform a listener. For example, when the computer 100 is connected to a telephone line interface that tells the computer 100 when the phone is ringing, a telephone-ring notification can be sent to a user who is outside or away from the telephone. When the computer 100 is interfaced a doorbell, a doorbell-ringing notification can be sent. An email notification can be sent when the computer 100 receives email. An alarm clock notification can be sent at a specified time. When the computer 100 is interfaced to an alarm system, an alarm notification can be sent. When the computer is interfaced to appliances or other devices that signal events, a corresponding notification can be sent.

Figure 3 is a flowchart that illustrates the operation of a notification function. The flowchart begins at a start block 302 and immediately advances to a decision block 304. In the decision block 304, the process checks to see if the telephone is ringing. If the telephone is ringing, the process advances to a process block 306; otherwise the process jumps back to the decision block 304. In the process block 306, a DA (digital audio) flag is cleared and the process advances to a decision block 308. In the decision block 308, the process checks to see if the audio peripheral is currently playing a digital audio program. If a digital audio program is being played, then the process advances to a process block 320; otherwise, the process advances to a process block 314.

In the process block 310, the DA flag is set and the process advances to a process block 312. In the process block 312, the audio peripheral mutes the digital audio program and the process advances to the process block 314.

In the process block 314, the audio peripheral plays an announcement message (e.g., "the telephone is ringing") and the process advances to a process block 316. In one embodiment, in the process block 314, the audio peripheral device provides text-to-speech synthesis and the device plays the synthesized speech.

In the process block 316, the DA flag is checked. If the DA flag is set, then the process advances to a process block 318; otherwise, the process jumps back to the process block 304. In the process block 318, the audio peripheral un-mutes the digital audio program and the process jumps back to the process block 304.

Other announcement messages are provided as well, such as announcements that the user has mail, that the doorbell is ringing, etc. The notification can include a text-to-speech translation of an email message.

In one embodiment, the peripheral device senses that the telephone has been picked up and automatically mutes, or reduces the volume of (quiet), the audio program. The audio program is restored when the peripheral device senses that the telephone has been hung up. Alternatively, the computer 100 can pause an audio program (e.g., suspend playback of a Compact Disk) during a telephone call and resume play when the telephone call ends. In a similar fashion, the audio device and computer 100 can mute, quiet, pause, or delay an audio program while transmitting a notification message,

While certain specific embodiments of the invention have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the present invention. Accordingly, the breadth and scope of the present invention should be defined only in accordance with the following claims and their equivalents.

WHAT IS CLAIMED IS:

1. A computer peripheral device that transmits audio data to a radio receiver, comprising:

a communication interface configured to receive digital audio data from a digital data bus;

a modulator configured to modulate said digital audio data onto a radio frequency carrier to produce a modulated radio frequency carrier; and

a transmitting antenna configured to convert said modulated radio frequency carrier into electromagnetic waves.

2. The computer peripheral device of Claim 1, wherein said communication interface is a Universal Serial Bus interface.

3. The computer peripheral device of Claim 1, wherein said modulated radio frequency carrier is a frequency-modulated carrier containing left-channel information and right-channel information, said frequency-modulated carrier configured to be received by a conventional FM-stereo receiver.

4. The computer peripheral device of Claim 1, further configured to send a notification message when a notification event occurs.

5. The computer peripheral device of Claim 4, wherein said notification event is a receipt of email.

6. The computer peripheral device of Claim 4, wherein said notification event is a telephone ring.

7. The computer peripheral device of Claim 4, wherein said notification event is an alarm.

8. The computer peripheral device of Claim 4, wherein said computer peripheral device is further configured to mute an audio program before sending said notification message and resume said audio program after sending said notification message.

9. The computer peripheral device of Claim 4, wherein said modulator comprises a digital to analog converter and an analog modulator.

10. The computer peripheral device of Claim 4, wherein said modulator comprises a digital modulator.

11. An apparatus that transmits audio data to a radio receiver, comprising:

a communication interface configured to receive digital audio data and commands from a digital data bus;

a modulator configured to convert said digital audio data into a modulated radio frequency signal; and

a transmitting antenna configured to convert said modulated radio frequency signal into electromagnetic waves.

12. The apparatus of Claim 11, wherein said apparatus draws operating power from said digital data bus.

13. The apparatus of Claim 12, wherein said commands include a frequency channel selection command to select a frequency channel for said modulated radio frequency signal.

14. The apparatus of Claim 12, wherein said commands include a modulation-type command to select a modulation format.

15. The apparatus of Claim 14, wherein said modulation format is frequency modulation.

16. The apparatus of Claim 11, wherein said digital data bus is a Universal Serial Bus.

17. An apparatus that transmits audio data to a radio receiver, comprising:

means for receiving digital audio data and commands from a digital data bus;

means for modulating said digital audio data into a modulated radio frequency signal; and

a transmitting antenna configured to convert said modulated radio frequency signal into electromagnetic waves.

18. A method for transmitting audio data from a computer to a radio receiver, comprising the acts of:

receiving digital audio data and commands from a digital data bus;

providing said digital audio data to a modulator to produce a modulated radio frequency signal; and

transmitting said radio frequency signal.

19. The method of Claim 18, further comprising the act of drawing operating power from said digital data bus.

20. The method of Claim 18, further comprising the act of sending a channel selection command to select a frequency channel for said modulated radio frequency signal.

21. The method of Claim 18, further comprising the act of sending a modulation command to select a modulation format.

22. The method of Claim 18, further comprising the act of sending an FM modulation command to select frequency modulation.

23. The method of Claim 18, wherein said act of receiving comprises receiving data from a Universal Serial Bus.

24. The method of Claim 18, wherein said act of receiving comprises receiving data from a FireWire Bus.

25. The method of Claim 18, further comprising the acts of:

receiving a notification message;

modulating said notification message; and

transmitting said notification message;

26. The method of Claim 25, wherein said notification message comprises at least one of: a doorbell-ringing notification; a telephone-ringing notification; an email notification; a time notification, and an event notification.

27. The method of Claim 25, further comprising the act of muting an audio program while transmitting said notification message.

28. The method of Claim 25, further comprising the act of delaying an audio program while transmitting said notification message.

29. The method of Claim 25, further comprising the act of pausing an audio program while transmitting said notification message and resuming said audio program after sending said notification message.

30. The method of Claim 18 further comprising the act of detecting that a telephone call is in progress and muting an audio program during said telephone call.

31. The method of Claim 18 further comprising the act of detecting that a telephone call is in progress and quieting an audio program during said telephone call.

32. The method of Claim 18 further comprising the act of detecting that a telephone call is in progress and pausing an audio program during said telephone call.

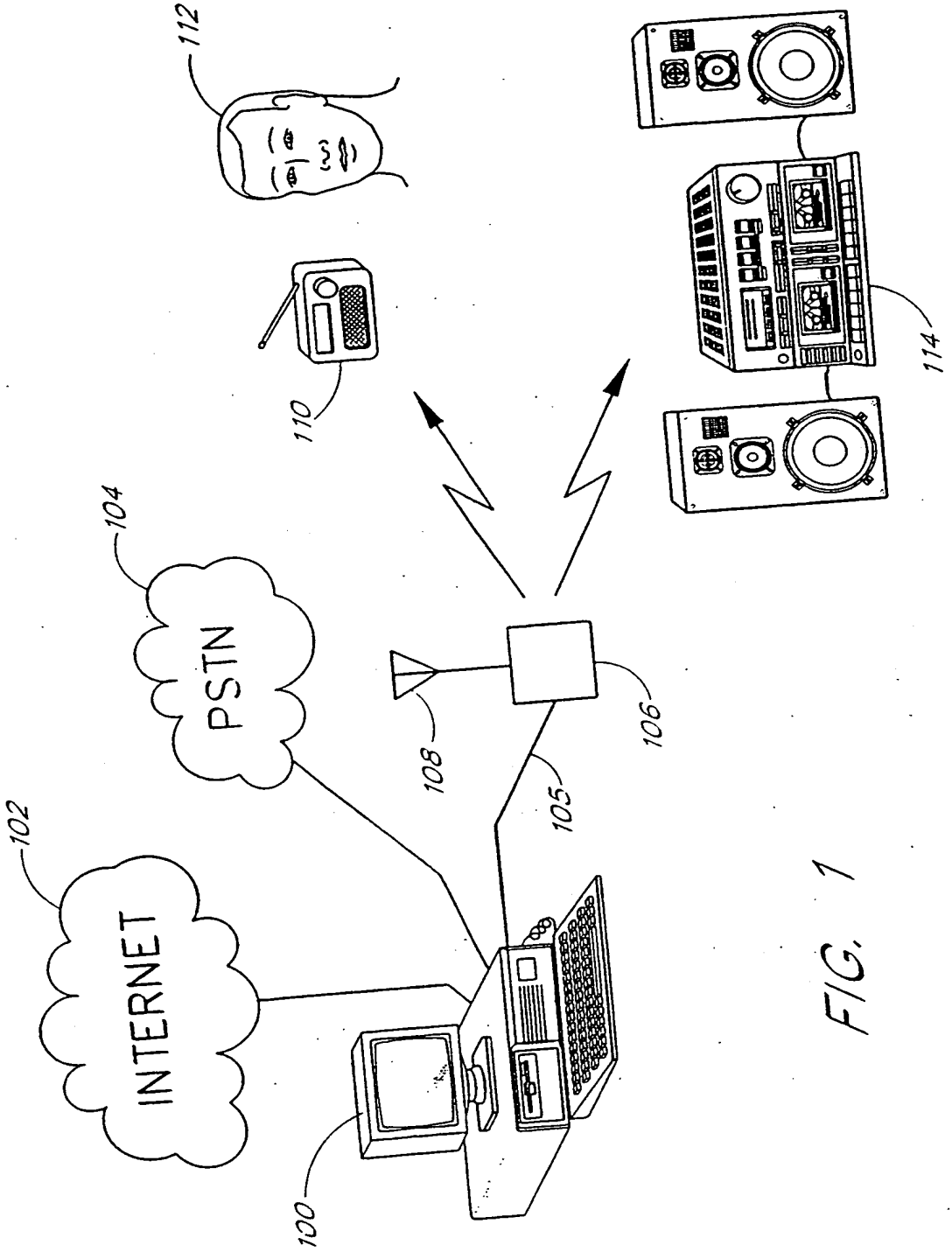

FIG. 1

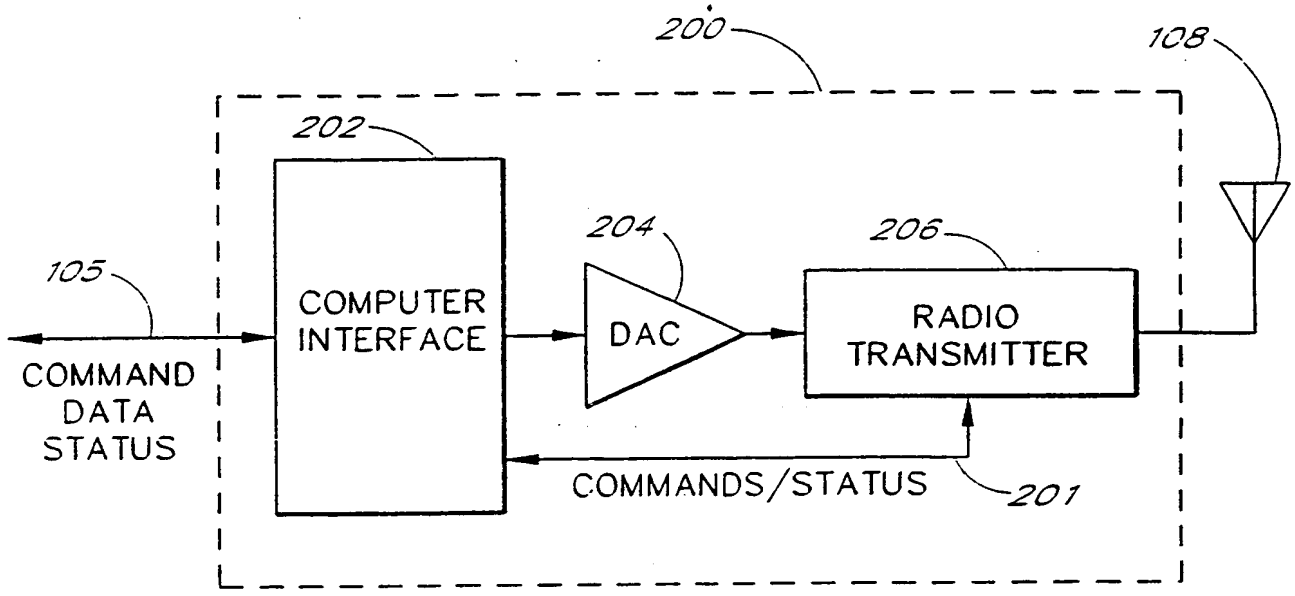

FIG. 2A

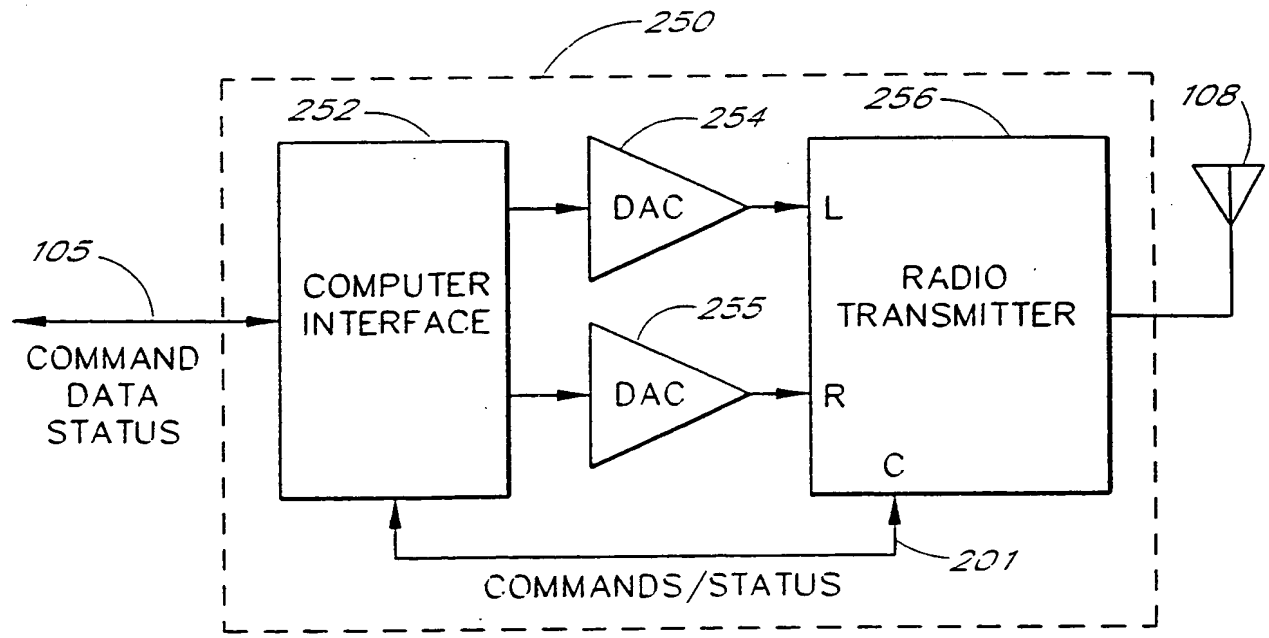

FIG. 2B

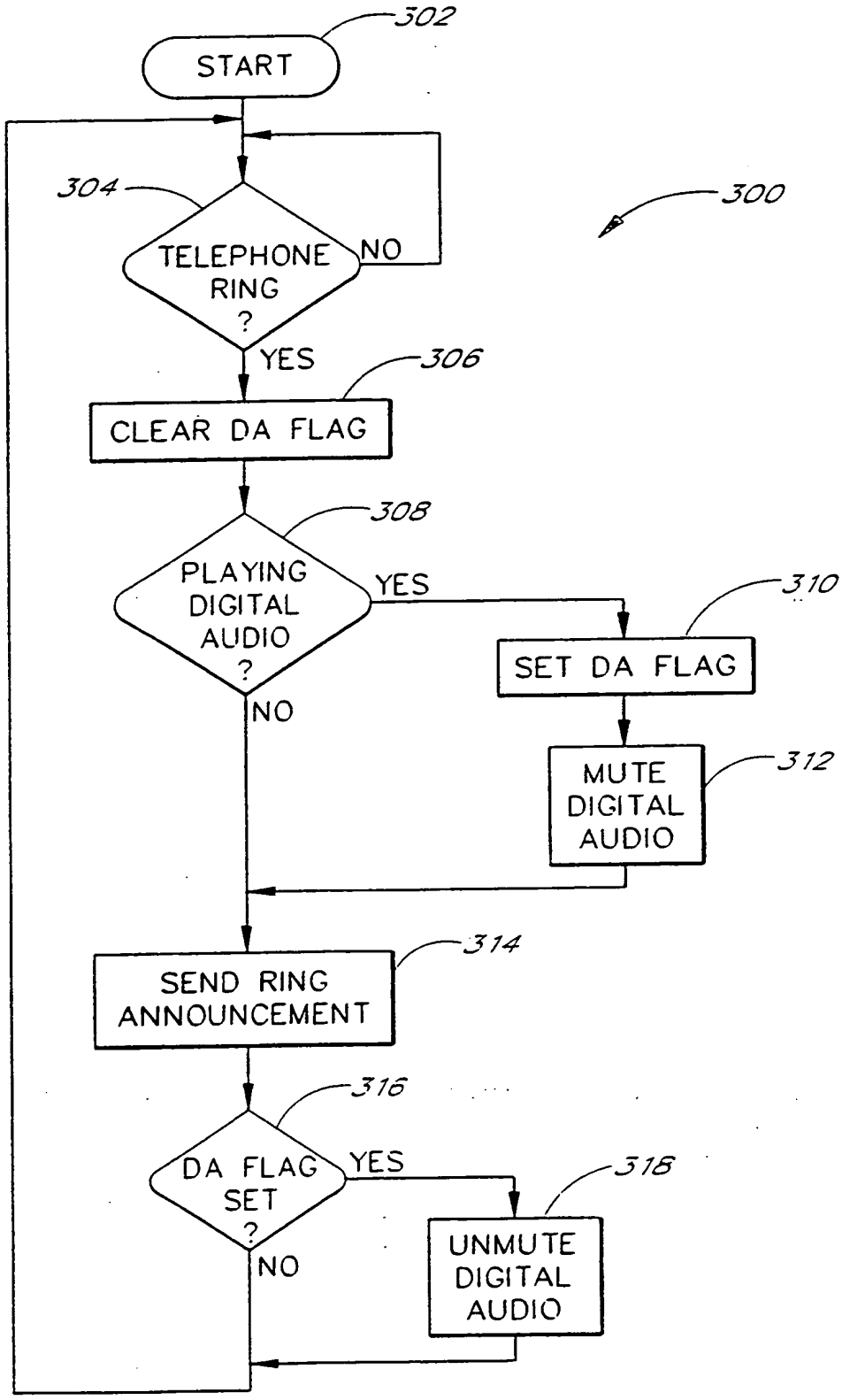

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/24187

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :G06F 13/12, 13/38; H04H 5/00, 7/00
US CL :381/2; 455/6.3; 710/69, 72
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 381/2; 455/6.3; 710/69, 72

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,673,323 A (SCHOTZ et al) 30 September 1997, entire doc.	1-32
X	US 5,675,390 A (SCHINDLER et al) 07 October 1997, Fig. 6, col. 18, lines 39-48.	1, 11, 17, 18
X,P	US 5,838,384 A (SCHINDLER et al) 17 November 1998, Figs. 1A & 1B, col. 6, lines 18-36, col. 7, lines 32-60.	1, 11, 17, 18

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